

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

<b>Date of mailing</b> (day/month/year) 27 February 2001 (27.02.01)	
<b>International application No.</b> PCT/EP00/05275	<b>Applicant's or agent's file reference</b> PCT 1182-009
<b>International filing date</b> (day/month/year) 07 June 2000 (07.06.00)	<b>Priority date</b> (day/month/year) 01 July 1999 (01.07.99)
<b>Applicant</b> MIKKELSEN, Svend-Erik et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

12 January 2001 (12.01.01)

☐ in a notice effecting later election filed with the International Bureau on:
2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Pascal Piriou Telephone No.: (41-22) 338.83.38
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(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
11 January 2001 (11.01.2001)

PCT

(10) International Publication Number  
**WO 01/02515 A1**

- (51) International Patent Classification: C10L 1/02 (74) Agent: GRÜNECKER, KINKELDEY, STOCKMAIR & SCHWANHÄUSSER; Maximilianstrasse 58, 80538 München (DE).
- (21) International Application Number: PCT/EP00/05275
- (22) International Filing Date: 7 June 2000 (07.06.2000) (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/141,834 1 July 1999 (01.07.1999) US (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- (71) Applicant (for all designated States except US): HALDOR TOPSOE A/S [DK/DK]; Nymollevvej 55, DK-2800 Lyngby (DK).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): MIKKELSEN, Svend-Erik [DK/DK]; Christianshøjvej 20, Kirke Værlose, DK-3500 Værlose (DK). LEHRMANN, Peter [DK/DK]; Hovedgaden 47D, 2.tv., DK-3460 Birkerød (DK). BØGILD HANSEN, John [DK/DK]; Villemoesgade 39, 2.tv., DK-2100 Copenhagen Ø (DK).

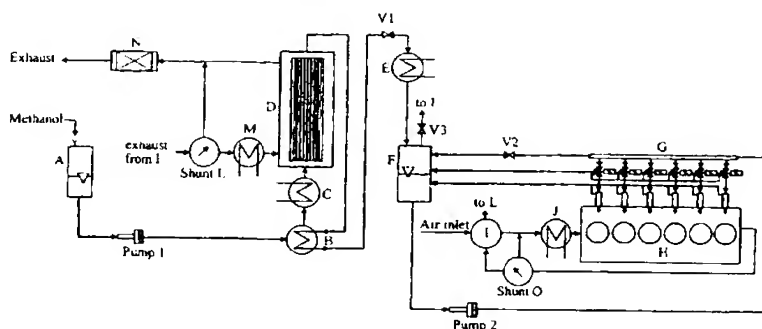
**Published:**

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CONTINUOUS DEHYDRATION OF ALCOHOL TO ETHER AND WATER USED AS FUEL FOR DIESEL ENGINES

Simplified Flow Sheet for Methanol to DME Fuel Processing Unit for Mobile or Stationary Diesel Engines



(57) Abstract: The present invention relates to an oxygenated fuel composition suitable for use in compression ignition internal combustion engines, equipped with inlet air heater, a catalytic alcohol dehydration equipment suitable for chemical equilibrium conversion of methanol and higher alcohol to their associated ether plus water. The generated fuels contain a synergetic combination of unconverted alcohol like methanol and ethanol and associated generated ether as dimethylether and diethylether and water. The generated fuel is injected as a liquid directly into the cylinders of the engine. The generated ether provides good ignition properties. The unconverted alcohol provides a stable single-phase fuel and the water results in a reduction in combustion temperature yielding very low concentration of nitrogen oxides in the exhaust gas. Another advantage associated with the obtained fuel compositions is very low formation of particulate matter. Experimental investigations have shown that high overall engine efficiency is obtained. The generated fuel compositions are used as main fuel for start and operation of the engine. Further the invention reduces the dependency of fossil liquid fuel as the alcohol feed used can be produced from natural gas and basically all carbon bearing substances like coal and renewable sources like wood.

WO 01/02515 A1

## INTERNATIONAL SEARCH REPORT

Internat Application No

PCT/EP 00/05275

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C10L1/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C10L F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 431 357 A (GUNNERMAN RUDOLF W) 12 June 1991 (1991-06-12)	1
Y	claims 1,3,6,11,15 ---	1,2,6
Y	US 4 422 412 A (NORTON JOHN H R) 27 December 1983 (1983-12-27) claims 1,2 column 3, line 40 - line 45 ---	1,2,6
A	GB 1 593 852 A (BURMAH OIL TRADING LTD) 22 July 1981 (1981-07-22) claims 1-3 ---	1,6
A	US 5 906 664 A (MIKKELSEN SVEND-ERIK ET AL) 25 May 1999 (1999-05-25) cited in the application -----	

☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

20 October 2000

Date of mailing of the international search report

27/10/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel (+31-70) 340-2040, Tx 31 651 epo.nl,  
Fax: (+31-70) 340-3016

Authorized officer

De Herdt, O

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 00/05275

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0431357 A	12-06-1991	AT 137529 T	15-05-1996
		AU 6337594 A	21-07-1994
		AU 654941 B	01-12-1994
		AU 6730290 A	13-06-1991
		BR 9007865 A	08-09-1992
		CA 2029654 A, C	23-05-1991
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US 4422412 A	27-12-1983	AU 541741 B	17-01-1985
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		ZW 28380 A	22-07-1981
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		AU 3036177 A	10-05-1979
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		DK 775185 T	08-02-1999
		EP 0775185 A	28-05-1997
		ES 2120221 T	16-10-1998
		FI 970575 A	08-04-1997

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 00/05275

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5906664 A		JP 3001263 B	24-01-2000
		JP 10504054 T	14-04-1998
		NO 970601 A	09-04-1997
		NZ 290675 A	19-12-1997
		RU 2141995 C	27-11-1999
		WO 9605274 A	22-02-1996
		ZA 9506333 A	11-03-1996
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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference PCT 1182-009		<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP00/05275	International filing date (day/month/year) 07/06/2000	Priority date (day/month/year) 01/07/1999
International Patent Classification (IPC) or national classification and IPC C10L1/02		
Applicant HALDOR TOPSOE A/S		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 12/01/2001	Date of completion of this report 16.11.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Rumbo, A Telephone No. +49 89 2399 8407 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP00/05275

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-23 as originally filed

**Claims, No.:**

1-5 as received on 21/05/2001 with letter of 18/05/2001

**Drawings, sheets:**

1/2,2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP00/05275

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	1-5
	No:	Claims	

Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-5

Industrial applicability (IA)	Yes:	Claims	1-5
	No:	Claims	

2. Citations and explanations  
**see separate sheet**



**SECTION V (NOVELTY AND INVENTIVE STEP)**

1. The claimed subject-matter does not meet the requirements of Article 33(3) PCT in view of D1 and D2 constitute the closest prior art documents.

1.1 D1=US-A-5 906 664 discloses the use of the DME, methanol and water combinations disclosed at claims 1 to 5 and examples 1 to 4 (see table 1) in an engine having a air-to-air intercooler for the turbocharger (see example 4, in particular col. 7, lines 39-43). It is well known that the normally working intercoolers cool the air entering into the cylinder from 600°C obtained after compression down to approximately 120°C.

1.2 D2=US-A-4 422 412 discloses a process for the dehydration of methanol to DME at temperatures ranging from 80 to 400°C (preferably from 250° to 350°C).

The claimed subject-matter meets the requirements of Article 33(2) PCT in view of each of D1 and D2 since at least the pressure for the process for obtaining DME disclosed in D2 is not explicitly cited (see in particular D2, col. 3, lines 3-10 wherein all the rest of the operational conditions are cited).

2 . Nevertheless the pressures at present in the wording of claim 1 are quite common operational conditions which could be used by the skilled person without involving any inventive step.

**The absence of at least an objectively solved technical problem as a consequence of a differentiating technical feature present in the wording of the independent claim, the inventive step of the claimed subject-matter cannot be acknowledged.**

In fact modifications which do not solve any technical problem can be considered as obvious for the skilled person and therefore not inventive according to Article 33(3) PCT. At present time nowhere in the application as filed it is disclosed that a technical problem can be solved by technical means been different from those well known for the skilled person defined in D1 and D2.

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>PCT 1182-009</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/EP 00/ 05275</b>	International filing date (day/month/year) <b>07/06/2000</b>	(Earliest) Priority Date (day/month/year) <b>01/07/1999</b>
Applicant <b>HALDOR TOPSOE A/S</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☒ because this figure better characterizes the invention.

2

☐ None of the figures.

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 C10L1/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C10L F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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X	EP 0 431 357 A (GUNNERMAN RUDOLF W) 12 June 1991 (1991-06-12)	1
Y	claims 1,3,6,11,15 ---	1,2,6
Y	US 4 422 412 A (NORTON JOHN H R) 27 December 1983 (1983-12-27) claims 1,2 column 3, line 40 - line 45 ---	1,2,6
A	GB 1 593 852 A (BURMAH OIL TRADING LTD) 22 July 1981 (1981-07-22) claims 1-3 ---	1,6
A	US 5 906 664 A (MIKKELSEN SVEND-ERIK ET AL) 25 May 1999 (1999-05-25) cited in the application -----	

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## \* Special categories of cited documents :

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

20 October 2000

Date of mailing of the international search report

27/10/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

De Herdt, O

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International Application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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		WO 9605274 A	22-02-1996
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

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A	GB 1 593 852 A (BURMAH OIL TRADING LTD) 22 July 1981 (1981-07-22)	1,6
	claims 1-3	
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☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

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Date of the actual completion of the international search

20 October 2000

Date of mailing of the international search report

27/10/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
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De Herdt, 0

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Information on patent family members

International Application No

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**PCT**

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2/5C24  
Arlington, VA 22202  
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in its capacity as elected Office

Date of mailing (day/month/year)  
27 February 2001 (27.02.01)

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07 June 2000 (07.06.00)

Applicant's or agent's file reference  
PCT 1182-009

Priority date (day/month/year)  
01 July 1999 (01.07.99)

Applicant

MIKKELSEN, Svend-Erik et al

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
12 January 2001 (12.01.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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Pascal Piriou

Telephone No.: (41-22) 338.83.38

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